

REMARKS/ARGUMENTS

Request for Continued Examination:

The applicant respectfully requests continued examination of the above-indicated application as per 37 CFR 1.114.

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Claim Rejections

Claims 1-6, 8-16, 20-28, 30-37, 41-46, 50, 78-83, 86-87, 90-93 and 97-103 are rejected under 35 USC 103(a) as being unpatentable over Bicknell et al. (US pub. 2003/0193776) in view of Meehan et al. (US pub. 2004/0177218) and further in view of Rinaldis et al. (US pat. 7,107,343).

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Contents of the arguments:

1. Regarding amended independent claim 78

(1a) Disc pack 118 in figure 3 of Bicknell is not equal to physical storage devices (PSDs) of the present invention.

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(1b) “expansion port for coupling to said second set of said PSDs” in the independent claim of the present invention has never been disclosed by paragraph 0024 of Bicknell.

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2. Regarding amended independent claim 90

(2a) Disc pack 118 in figure 3 of Bicknell is not equal to logical media unit (LMU) of the present invention

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(2b) “to present redundantly the at least one LMU through at least two of said plurality of host-side IO device interconnect ports” in claim 90 of the present invention has never been disclosed by paragraph 0024 of Bicknell.

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3. Regarding amended independent claim 1

“can be” in claim 1 is amended to “is”.

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4. Explanations to new limitations merged into all the amended

independent claims 1, 21, 78 and 90

New limitations are merged into the amended independent claims 1, 21, 78, and 90.

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Detailed explanation to the arguments regarding amended independent claims 1, 21, 78 and 90 will be provided as follows.

1. Regarding amended independent claim 78

10 Applicant respectfully disagrees with the Examiner's rejections to claim 78 because of the following reasons (1a) and (1b):

(1a) disc pack 118 in figure 3 of Bicknell is not equal to physical storage devices (PSDs) of the present invention; and,

15 (1b) "expansion port for coupling to said second set of said PSDs" in claim 78 of the present invention has never been disclosed by paragraph 0024 of Bicknell. The explanations will be given as follows.

(1a) Independent claim 78 comprises the patentably distinct feature of "wherein said group of PSDs include a first set of PSDs and a second set of PSDs, said first set of PSDs and said second set of PSDs are not received in a same enclosure, and said storage virtualization controller further comprises at least one multiple-device device-side expansion port for coupling to said second set of said PSDs."

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On the page 3, lines 3 to 9, the examiner deems that "discs in the disc pack 118 of disc drives 106, as discloses in paragraph 0018; see also fig. 3 and 6. A group of PSDs, for example, is four discs in two separate disc packs 118 in two separate disc drives 106. Therefore, a first set of PSDs is two discs in a disc pack of a disc drive and a second set is two other discs in another disc pack of another disc drive. Each disc drive has its own enclosure, as discloses in fig. 3 of Bicknell. See also paragraph 0024 of Bicknell, which disclose the controllers having ports".

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After careful review, applicant respectfully disagrees with the Examiner's above opinion that "a first set of PSDs in two discs in a disc pack of a disc drive". **In fact, "the disc in the disc pack 118" is not equal to "the PSD in the claimed invention".**

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Please also refer to the paragraphs [0044] and [0045] (as below) and Fig. 3 of **the present invention, which clearly illustrate that a PSD (abbreviated from Physical Storage Device) is a storage device like a hard disk drive (HDD).**

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*"[0044] The host entity 10 can be a host computer, such as a server system, a workstation, a PC system, or the like. **The SVS 20 comprises a storage virtualization controller 200,** which can be a RAID controller or a JBOD emulator, **and a physical storage device array (PSD array) 400** connected by Serial ATA interconnect 201. Although only one PSD array 400 is illustrated here, more than one PSD array 400 can be attached to the SVC 200. Also, the host entity 10 can be another SVC."*

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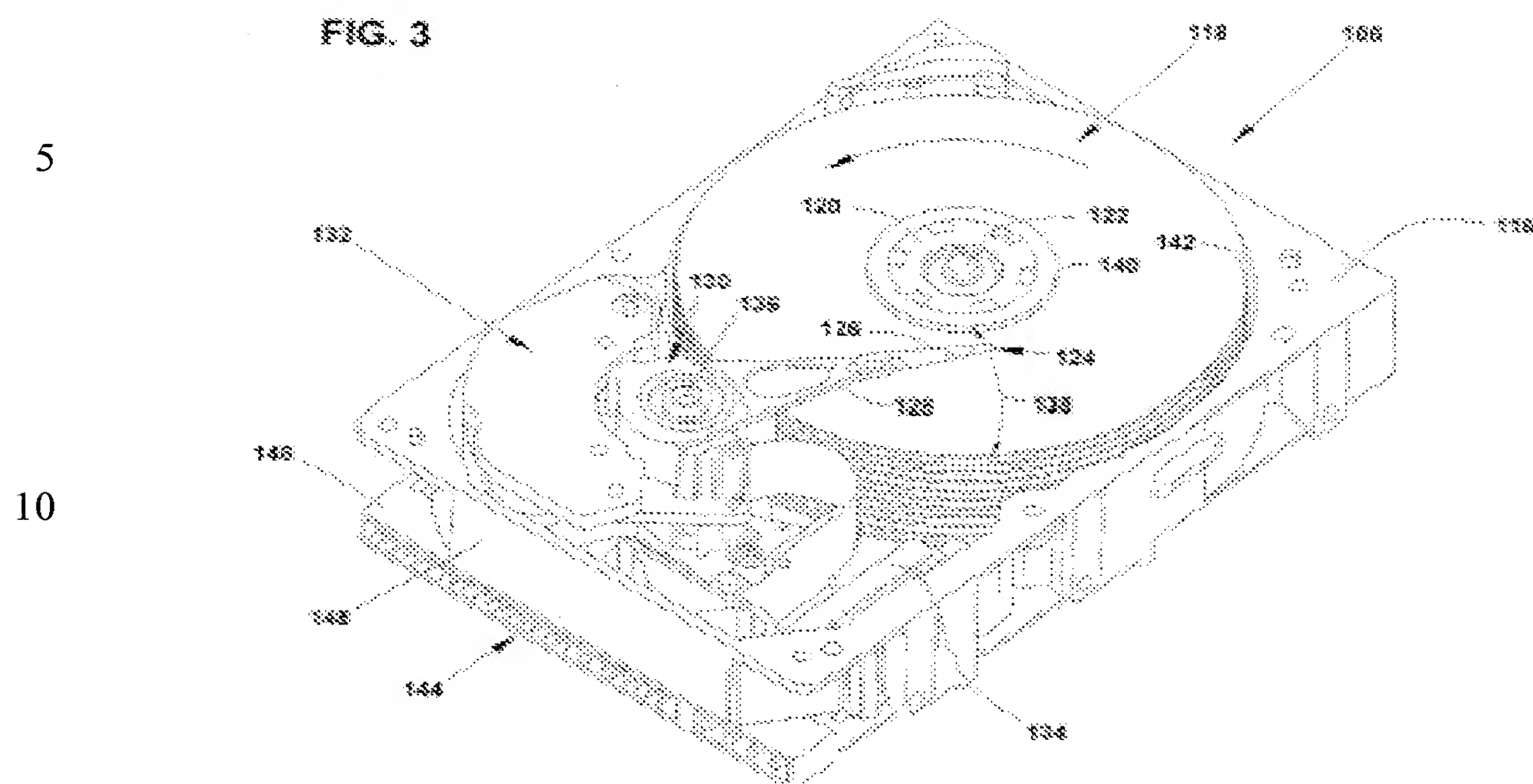
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*"[0045] The SVC 200 receives IO requests and related data (the control signals and data signals) from the host entity 10 and executes the IO requests internally or maps the IO requests to the PSD array 400. **The PSD array 400 comprises a plurality of physical storage devices 420, which can be hard disk drives (HDD), for example.** The SVC 200 can be used to enhance performance and/or improve data availability and/or increase storage capacity of a single logical media unit in view of the host entity 10."*

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Please refer to the following paragraph 0018 and fig. 3 of Bicknell.

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15 [0018] Disc drive assemblies 104 each include a disc drive 106 that is contained in a carrier 114. FIG. 3 is an isometric view of an example of a disc drive 106 that can be used with disc storage subsystem 100. Disc drive 106 includes a housing with a base 116 and a top cover (not shown). Disc drive 106 also includes a disc pack 118, which is mounted on a spindle motor (not shown) by a disc clamp 120. Disc pack 118 includes a plurality of individual discs, which are mounted for co-rotation about central axis 122. Each disc surface has an associated disc head slider 124 which is mounted to disc drive 106 for communication with the disc surface. In the example shown in FIG. 3, sliders 124 are supported by suspensions 126, which are in turn attached to track accessing arms 128 of an actuator 130. Actuator 130, shown in FIG. 3, is of the type known as a rotary moving coil actuator and includes a voice coil motor, shown generally at 132. Voice coil motor 132, under the

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control of servo electronics 134, rotates actuator 130 with its attached heads 124 about a pivot shaft 136 to position heads 124 over a desired track along an arcuate path 138 between a disc inner diameter 140 and a disc outer diameter 142.

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The above figure 3 and paragraph 0018 of Bicknell disclose the structure of a hard disc drive 106 (i.e., disc drive 106). “The disc drive 106 includes **a housing with a base 116 and a top cover (not shown).**” “Disc drive 106 also includes a disc pack 118, which is mounted on a spindle motor (not shown) by a disc clamp 120. Disc pack 118 includes a plurality of individual discs, which are mounted for co-rotation about central axis 122.”

That is, the disc in the disc pack 118 is the storage media having magnetic material coated thereon for storing data therein. Therefore, **the disc is a component in the disc drive 106.**

Moreover, the disc pack 118 is a stack of discs mounted on a spindle motor for co-rotation about central axis 122. Therefore, **the disc pack 118 is also a component in the disc drive 106.**

Furthermore, the “**housing with a base 116 and a top cover**” is simple a **casing for a disc drive 106**, not an enclosure for a plurality of HDDs.

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From the above explanations to the PSD of the present invention and the figure 3 and paragraph 0018 of Bicknell, it can be concluded

(A) that **a disc drive 106 is a hard disc drive (HDD), and therefore the disc drive 106 is a kind of PSD. The components in the disc drive 106 are not equal to PSD.**

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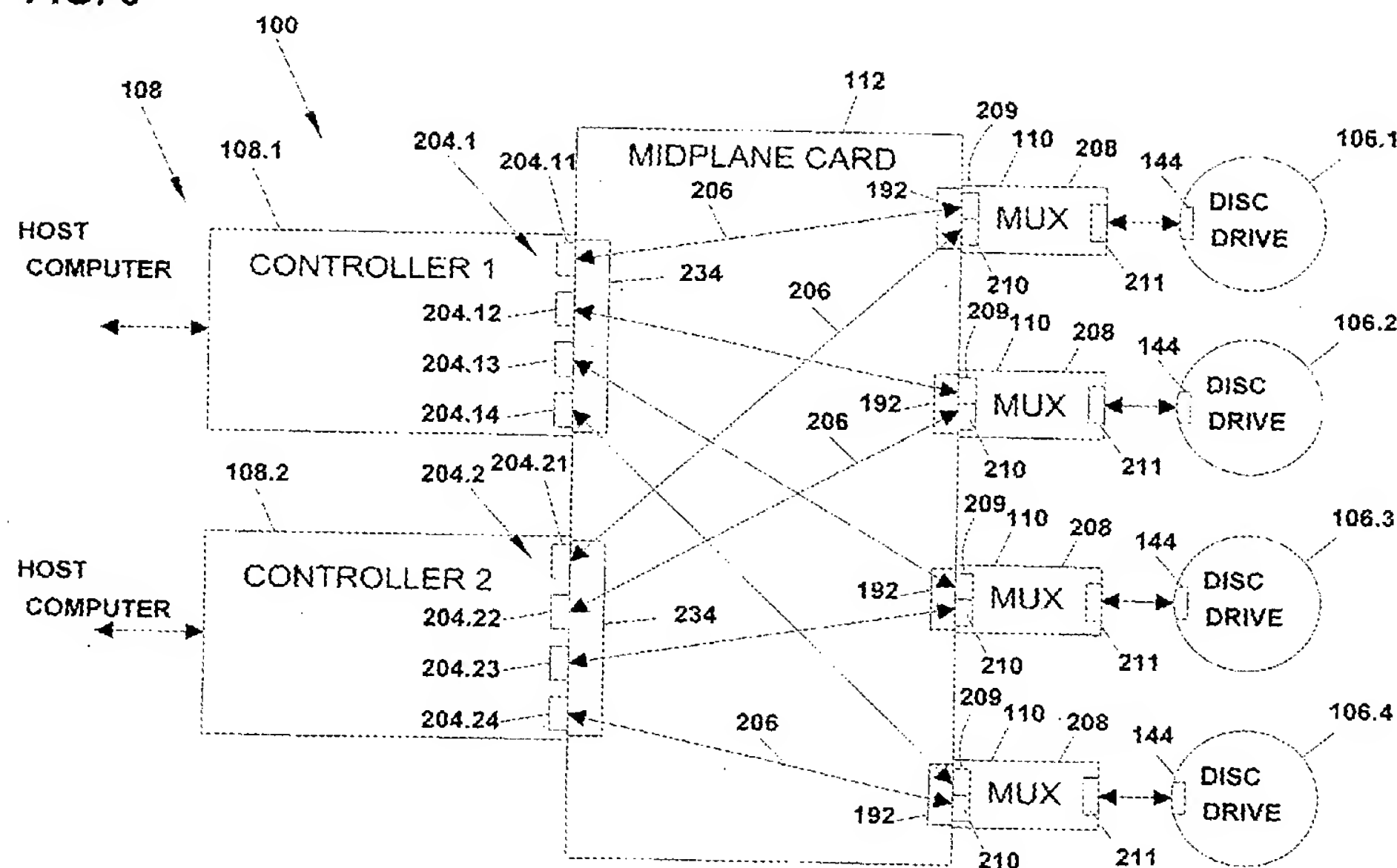
(B) that **disc packs 118 in figure 3 of Bicknell is not equal to physical storage device (PSD) of the present invention**, where the disc of Bicknell is merely a component part of disc drive 106, not the whole PSD of the present invention, and the disc pack 118 of Bicknell is also merely a component part of disc drive 106, not the PSDs of the present invention.

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- (C) that **“a group of PSD in the present invention comprising a first set of PSDs and a second set of PSDs, both of which are not received in a same enclosure” is not equal to “two discs in a disc pack of a disc drive and a second set is two other discs in another disc pack 118 of another disc drive as disclosed in Fig. 3 of Bicknell”**, in which Bicknell discloses that the disc pack 118 is contained in disc drive 106, i.e., in the **housing with a base 116 and a top cover (not shown)**, while the present invention discloses that the plurality of PSDs are contained in different enclosures, and the disc pack 118 is not equal to PSDs as stated in aforesaid point (B), and
- (D) that please refer to paragraph 0018 and the Fig. 3 of Bicknell, both of which merely describe and explain the inner structure of disc drives 106, which is entirely different from the independent claim of the present invention which does not relate to the inner structure of disc drives at all.
- (1b) “Expansion port for coupling to said second set of said PSDs” in the independent claim of the present invention has never been disclosed by fig. 6 and paragraph 0024 of Bicknell.

Please refer to the following fig. 6 and paragraph 0024 of Bicknell.

FIG. 6



[0024] Controllers 108 are configured to communicate with and control each disc drive 106 in the disc storage subsystem 100. Each controller 108 includes, along with other control electronics, an interface 200 having a connector 201, and cache memory 202, as illustrated in FIGS. 1 and 2. Data and control signals are communicated through interface 200. External processing electronics, such as a host computer, can access data stored in disc drives 106 through each of the controllers 108.

From above paragraph 0024 of Bicknell, it can be known that paragraph 0024 of Bicknell merely discloses basic configuration of RAID system, but fails to disclose such an “expansion port for coupling to said second set of said PSDs” in the independent claim of the present invention.

Moreover, again in order to explain more regarding the meaning of “expansion port for coupling to said second set of said PSDs”, please refer to paragraph [0092] of

the present invention. Because the S-ATA specification only allows for maximum signal line lengths of 1.5 meter, the PSDs connected to one SVC must be packed close enough so that no signal line length exceeds 1.5meter. A typical S-ATA storage virtualization subsystem will only provide for connection of a maximum of 16 S-ATA PSDs because of these limitations. So, a "pure" S-ATA storage virtualization subsystem is unable to match the expandability of a Fibre FC-AL storage virtualization subsystem, which will typically allow for connection of up to 250 PSDs via connection of external expansion chassis on the same set of device-side IO device interconnects. [0093] In order to overcome this limitation, the present invention optionally includes one or more expansion device-side multiple-device IO device interconnects, herein referred to as device-side expansion ports, such as Parallel SCSI or Fibre FC-AL on the SVC. These interconnects will typically be wired in such a way as to allow external connection of external expansion chassis. These chassis could be simple "native" just a bunch of drives (JBODs) of PSDs directly connected to the interconnect without any intervening conversion circuitry or could be intelligent JBOD emulation subsystems that emulate "native" JBODs using a combination of S-ATA or P-ATA PSDs and a single or redundant set of SVCs that provide the conversion from the multiple-device IO device interconnect protocol that provides the connection of the JBOD subsystem to the primary storage virtualization subsystem to the device-side IO device interconnect (S-ATA or P-ATA) protocol that provides the connection between the JBOD SVC(s) and the PSDs that they manage. Therefore, in the claims of the present invention, said storage virtualization controller further comprises at least one multiple-device device-side expansion port for coupling to said second set of said PSDs.

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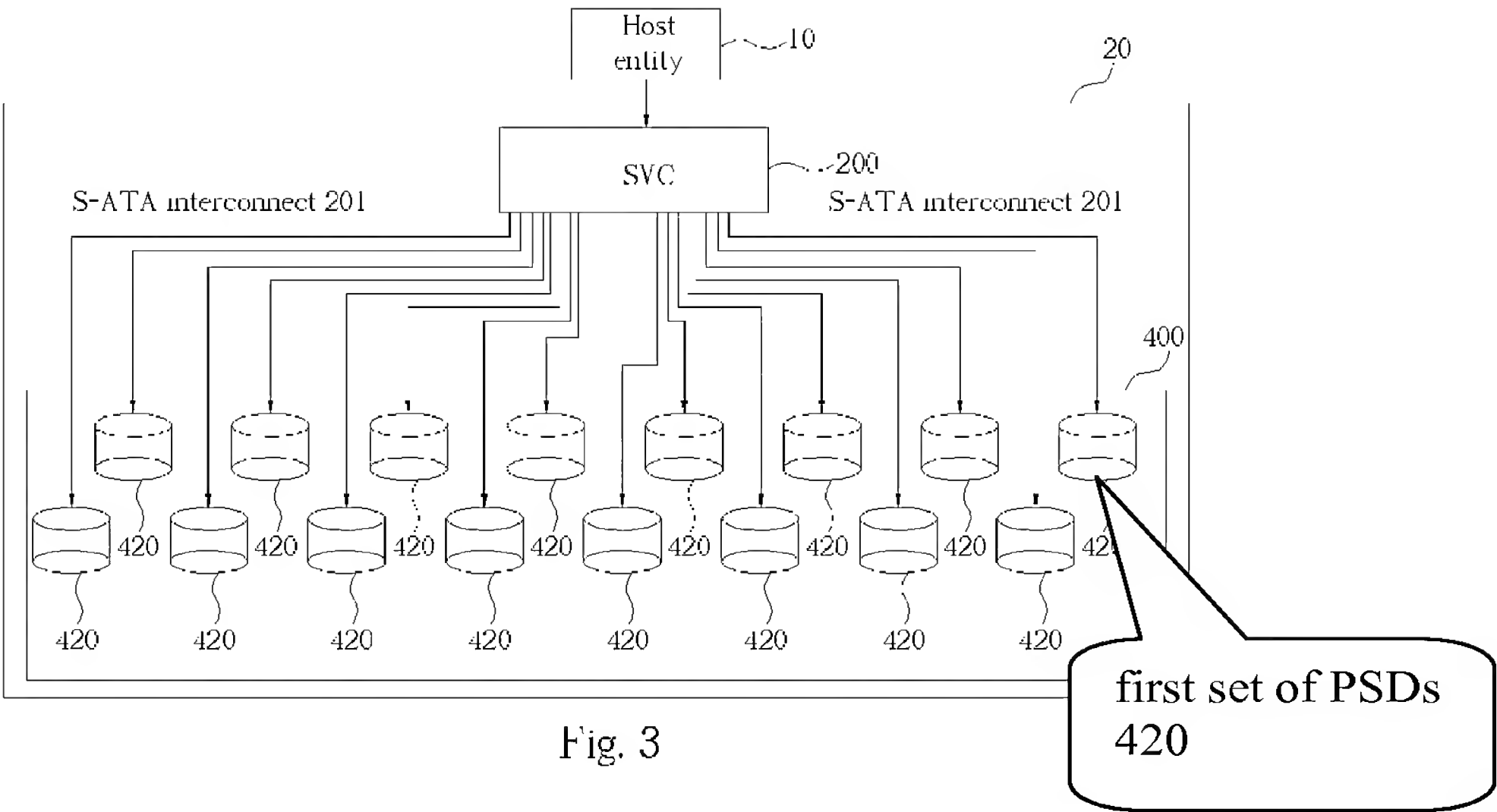


Fig. 3

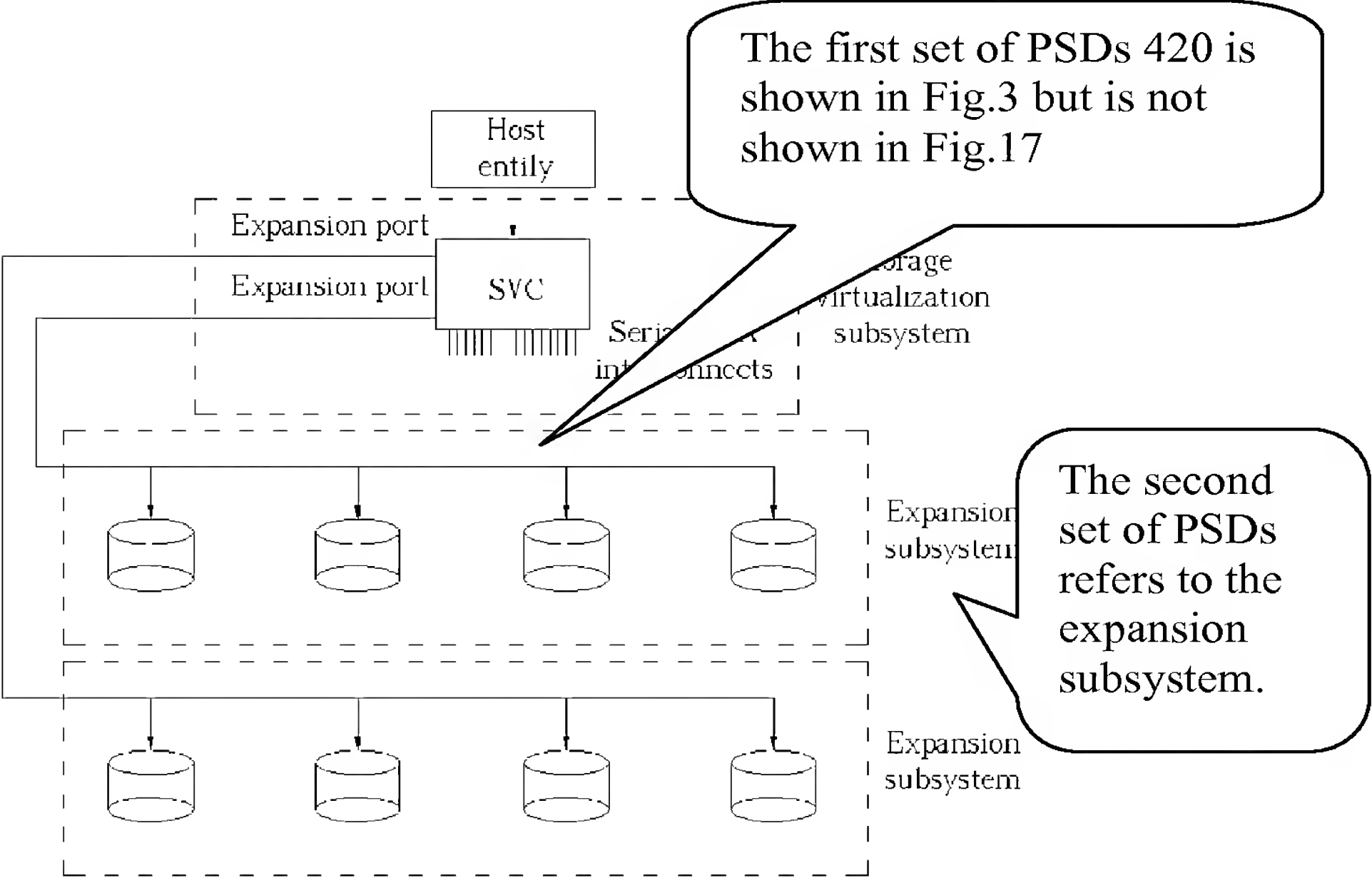


Fig. 17

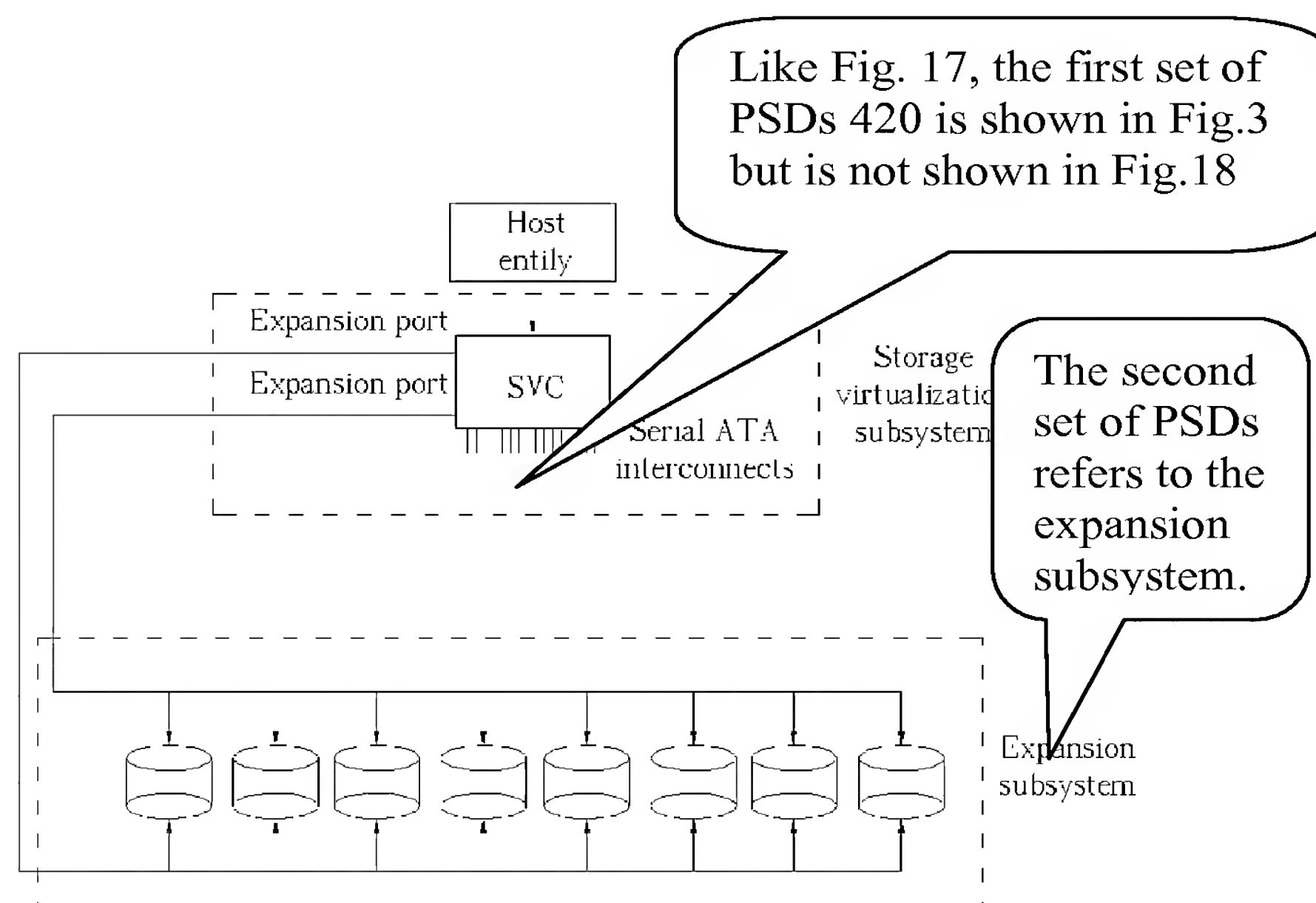


Fig. 18

Moreover, please refer to above figs. 3, 17 and 18 of the present invention, in which in fig.3, there are 16 S-ATA interconnects 201 connected to **local** physical storage device array (PSD) 400 which comprises a plurality of physical storage devices 420 **(i.e., said first set of PSDs in fig.3 and in amended independent claims 78)**. However, please refer to above figs. 17 and 18, in which in addition to the 16 Serial ATA interconnects that are connected to local PSD 400 (please refer to fig.3), storage virtualization controller (SVC) can optionally have more **expansion subsystems (i.e., said second set of said PSDs in fig. 17 and 18 and in amended independent claims 78) through the device-side expansion port for coupling to said second set of said PSDs (i.e., said expansion subsystem which is indicated by dotted lines in figs. 17 and 18).**

2. Regarding amended independent claim 90

Applicant respectfully disagrees with the Examiner's rejections to claim 90 because of the following reasons (2a) and (2b):

(2a) Disc pack 118 in figure 3 of Bicknell is not equal to logical media unit (LMU) of the present invention, and

5 (2b) “to present redundantly the at least one LMU through at least two of said plurality of host-side IO device interconnect ports” in claim 90 of the present invention has never been disclosed by paragraph 0024 of Bicknell. The explanations will be given as follows.

(2a) Disc pack 118 in figure 3 of Bicknell is not equal to logical media unit (LMU) of the present invention.

10 On the page 3, second paragraph, the examiner deems that “fig. 3 and paragraph 0018 of Bicknell with discloses disc pack 118, which is being equated to “logical media unit”, which applicant of the present invention respectfully disagrees with because of the following reasons.

15 The logical media unit (LMU) of the present invention consists of sections of PSDs, and is formed in a manner that maps combination of the sections of the PSDs and the mapping is from the sections of the PSDs to the LMU visible to the host entity, and the LMU is contiguously addressable by the host entity to which the at least one LMU is made available.

20 **In fact, the LMU is a result after virtualization from the PSDs (such as HDDs). In the present invention, the storage virtualization controller (SVC) virtualizes the PSD array into one or more LMUs.** For example, four HDDs can be virtualized into an LMU of RAID 5, which has a size of three HDDs, or n HDDs can be virtualized into an LMU of RAID 5, which has a size of (n-1) HDDs. Or, four HDDs can be virtualized into a LMU of RAID 1 (mirroring), which has a size of two
25 HDDs, or m HDDs can be virtualized into an LMU of RAID 1, which has a size of (m/2) HDDs. Or, four HDDs can be virtualized into a LMU of RAID 0 (striping), which has a size of four HDDs, or p HDDs can be virtualized into an LMU of RAID 0, which has a size of p HDDs.

30 In contrast, regarding the meaning of disc pack 118 in figure 3 of Bicknell,

please refer to point (1a), the disc pack 118 is a stack of discs mounted on a spindle motor for co-rotation about central axis 122. Therefore, **the disc pack 118 is a component part in the disc drive 106 (HDD 106), and the disc drive 106 is a kind of PSD.**

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From the above explanations to the LMU of the present invention and the figure 3 and paragraph 0018 of Bicknell, it can be concluded **disc pack 118 is a component part in a hard disc drive 106**, and thus is totally different from the LMU of the present invention, which is formed by the fact **that the SVC virtualizes a plurality of**
10 **PSDs into one or more LMUs visible to and contiguously addressable by the host entity.**

(2b) Amended independent claim 90 comprises the patentably distinct feature of **“wherein the external storage virtualization controller is configured to present**
15 **redundantly the at least one LMU through at least two of said plurality of host-side IO device interconnect ports.”**

On the page 3, second paragraph, the examiner deems that “paragraph 0029 of Meehan discloses a controller having a “host-side IO device interconnect port. Having a disc pack connected to a controller port that’s connected to a host is being equated to
20 the limitation above.”

After careful review, applicant of the present invention respectfully disagrees with the Examiner’s above opinion because of the following reasons.

Please refer to paragraph [0098] of the present invention, in which another feature that an SVC might typically implement is redundancy in the host-side
25 interconnects in which multiple host-side interconnect ports are included on the SVC and **LMUs are presented to the host identically over two or more of these interconnects.** This feature is designed to allow the host the ability to maintain access to the LMU even if one of the interconnects and/or ports on the interconnect should break, become blocked or otherwise malfunction. That is, said storage virtualization
30 controller is **configured to present redundantly the at least one LMU through at**

least two of said plurality of host-side device interconnect ports twice.

In contrast, paragraph 0029 of Meehan have never disclosed such a “present redundantly” in the present invention. Please refer to the following fig. 6 and paragraph 0029 of Meehan.

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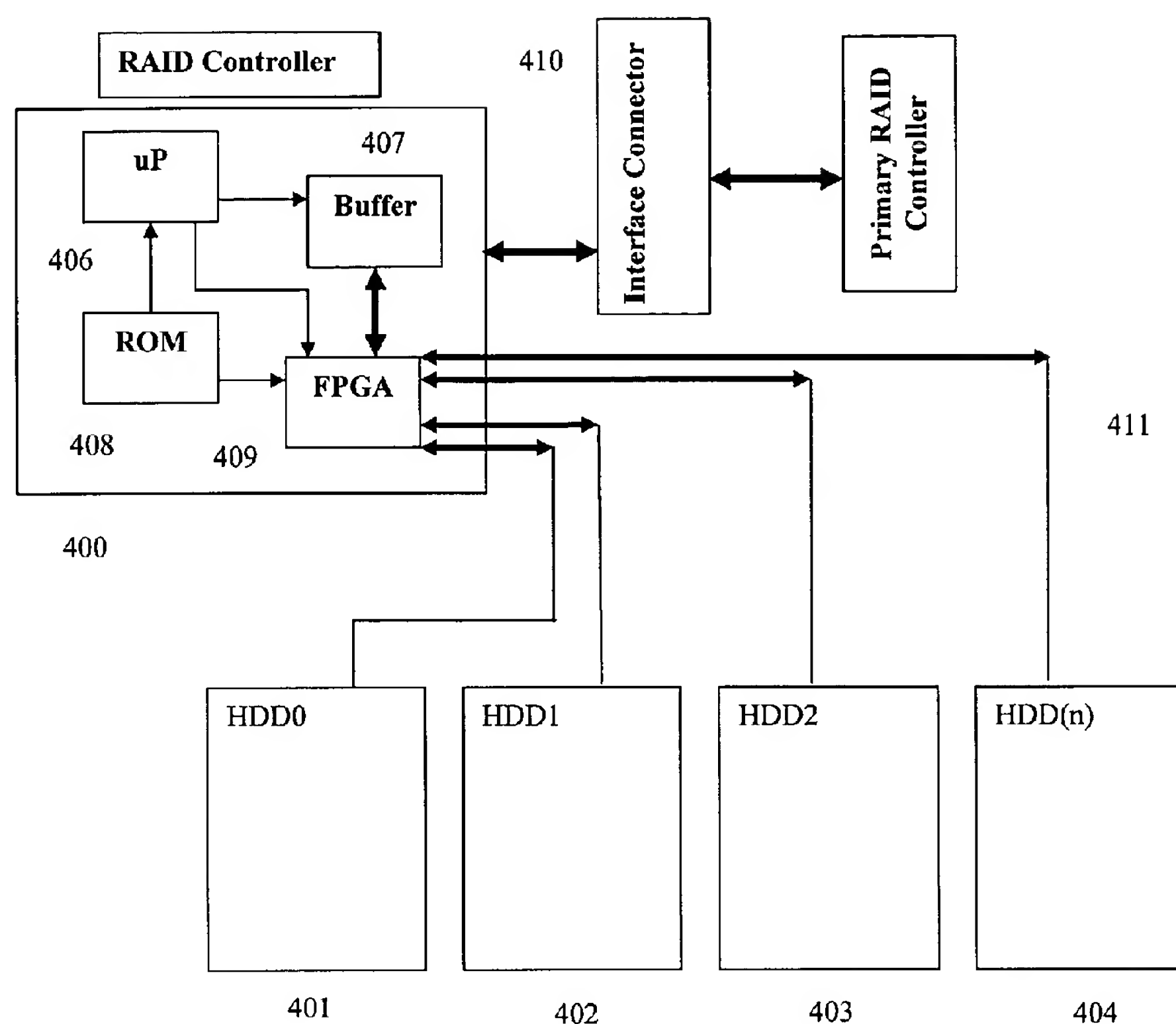


Figure 6

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[0029] Data to be written to storage disks 401-404 would move from the primary RAID Controller (from the host), through the Interface connector 410, and into the buffer RAM 407 of RAID Controller 400. Depending on the configuration setting as defined by, for example, the code in ROM 408, the RAID Controller would

5 *determine the RAID algorithm to use to distribute the data. In a RAID
5 configuration, for instance, the ROM would instruct the FPGA to
disassemble the data into a RAID 0 stripe, and calculate parity for
the data stripe, RAID 4/5. The data would then move through the
RAM and FPGA, where the stripe and parity is calculated and
attached to the data, before being sent to the storage devices 401-404.
In the case of reading from the storage devices, the process would
operate in reverse. Given that the RAM 407, ROM 408, and FPGA
409 are manipulating the data to and from the storage devices, it
10 would be possible to manage the data in any desired form required
by/for the storage devices, RAID controller, and host bus adaptor,
such as SCSI, ATA, FC, SATA, SAS or other command interfaces. For
example, data may be transmitted between the RAID controllers and
storage devices by means of an SCA or other type Interface
15 Connector 410. It is to be appreciated that the
calculations/operations of the FPGA can be done in software using a
software algorithm (e.g., stored on ROM) executed by a processor
such as CPU 406 or other dedicated processor.*

20 From above explanation to the present claimed invention and the figure 6 and
paragraph 0029 of Meehan, it can be concluded that **Meehan fails to disclose “two of
said plurality of host-side IO device interconnect ports”**, through which, the
“present redundantly” in the independent claim 90 of the present invention can be
achieved, and thus the figure 6 and paragraph 0029 of Meehan fail to disclose “present
25 redundantly” in the independent claim 90 of the present invention.

 In conclusion, it is asserted by the applicant that Bicknell fails to teach or suggest
**“wherein said storage virtualization controller is configured to present
redundantly a logical media unit on at least two of said plurality of host-side
device interconnect ports.” in amended independent claim 90.**

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3. Regarding amended independent claim 1

“can be” in claim 1 is amended to “is”.

Amended independent claim 1 comprises the patentably distinct feature of
5 **“wherein a new PSD is attached to said external storage virtualization controller
when said external storage virtualization controller is on-line.”** In other words, a
new PSD is attached to the external SVC even though the external SVC is on-line.

Through such an amendment from “can be” to “is”, it is believed that “intended
use” can be solved. Moreover, paragraph 0030 of Bicknell discloses, explains and
10 describes the types of functions of disc drive interface 211 and the controller
interfaces 209 and 210, but the applicant asserts that paragraph 0030 of Bicknell fails
to teach or suggest that a **new PSD is attached to said storage virtualization
controller when said storage virtualization controller is on-line.**

15 4. Explanations to new limitations merged into all the amended independent claims 1, 21, 78 and 90

In order to overcome the rejections in the OA of 09/30/2009 made by the
examiner, the applicant merges new limitation **“wherein said external storage
virtualization controller is configured to define at least one logical media unit (LMU)
20 consisting of sections of said group of PSDs, and is configured to provide a mapping
that maps combination of the section of said group of PSDs to the at least one LMU
visible to the host entity, and the at least one LMU is contiguously addressable by the
host entity to which the at least one LMU is made available”** into all independent
claims respectively.

25 Regarding the explanation to the new limitations about LMU above, please
refer to above point (2a), in which the LMU is formed by the fact that the SVC
virtualizes a plurality of PSDs into one or more LMUs visible to and contiguously
addressable by the host entity.

30 Moreover, according to MPEP 2143.03, **“All words in a claim must be**

considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). In addition, according to **MPEP 2106 II C, "Finally, when evaluating the scope of a claim, every limitation in the claim must be considered. USPTO personnel may not**
5 **dissect a claimed invention into discrete elements and then evaluate the elements in isolation. Instead, the claims as a whole must be considered. See e.g., Diamond v. Diehr, 450 U.S. 175, 188-89, 209 USPQ 1, 9 (1981)"** In view of the MPEP paragraphs, it is believed that each of aforesaid points 1 to 4 should be taken into consideration, and all the limitations explained in aforesaid points 1 to 4 should be
10 considered as a whole. The applicant of the present invention begs examiner's favor in examining those points 1 to 4 according to MPEP 2143.03 and MPEP 2106 II C.

Therefore, Applicant believes that all independent claims are now patentably distinct from the cited references, separately or in combination, and thus are in
15 condition for allowance.

Since the amended independent claims of the present invention are in condition for allowance, all dependent claims depending on the amended independent claims should be allowable, too.

20 **Conclusion**

In conclusion, the applicant respectfully submits that all of the rejections set forth in the Office Action of September 30, 2009 have been overcome and the pending claims are now in condition for allowance. If a telephone conference would facilitate the prosecution of this application, the Examiner is invited to contact the undersigned applicant's
25 representative at the number indicated below.

Sincerely yours,

/Winston Hsu/

Date: 03/30/2010

Winston Hsu, Patent Agent No. 41,526

5 P.O. BOX 506, Merrifield, VA 22116, U.S.A.

Voice Mail: 302-729-1562

Facsimile: 806-498-6673

e-mail : winstonhsu@naipo.com

- 10 Note: Please leave a message in my voice mail if you need to talk to me. (The time in D.C. is 12 hours behind the Taiwan time, i.e. 9 AM in D.C. = 9 PM in Taiwan.)